NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

April 16, 2002

SUBJECT: Next Generation Chemical and Biological Sensors and Sensing Systems

Dear Colleague:

The Division of Chemistry (CHE), the Division of Chemical and Transport Systems (CTS), the Division of Materials Science (DMR), and the Division of Bioengineering and Environmental Systems (BES) are coordinating efforts focused on research underlying the development of next generation chemical and biological sensors and sensing systems. This letter is to inform the sensor communities that NSF welcomes requests for supplements to existing grants and proposals for Small Grants for Exploratory Research in the area of sensor research.

Introduction and Rationale

New challenges requiring advanced chemical and biological sensing were highlighted by recent bioterrorism activities following the September 11 attacks on the World Trade Center and the Pentagon. It is essential to quickly and accurately detect and identify in real time, a wide range of toxic chemicals, explosives and biological agents, especially at very low levels in gases, in liquids, and on surfaces. There are numerous other uses of sensors, including production process engineering, environmental monitoring, ascertaining food quality, and transportation engineering. Advances in computer hardware and software provide the potential for numerous beneficial uses of information gathered by sensors and sensing systems. Smarter, faster and cheaper sensors could enhance productivity, efficiency, safety, and security. For civilian-security applications, convenience, reliability, and low cost (such as that associated with “smoke detectors”) are desired.

At present NSF supports a sizable sensor-relevant-research portfolio dispersed throughout the Foundation in fields such as chemistry, chemical engineering, materials science, electrical engineering, biology, and oceanography. It is time to focus basic research efforts on increased communication among disciplines in order to plan strategies and investments for developing the next generation of sensors and sensing systems. The four Divisions will work together to coordinate and evaluate requests for Supplements to existing NSF grants as well as to support Small Grants for Exploratory Research for new

and current Principal Investigators. The rationale for this action is based in part on the recommendations of a workshop held January 9-10, 2002. The workshop report is available at: http://www.chemistry.gatech.edu/sensingforum-02/

Research Scope

The goal of this effort is to speed advancements in the understanding, development, and applications of sensors. Specifically, improved and more reliable materials and protocols are sought which result in higher sensitivity, fewer false alarms, wireless operation, multifunctionality (e.g. simultaneous detection of both chemical and biological species), practicality, etc. Sensing principles include but are not limited to optical, electrochemical, electrical, acoustic, and mass sensing phenomena. Multidisciplinary efforts are encouraged. Specific research areas might include but are not limited to:

1. Synthesis and testing of new low cost materials with high sensitivity, selectivity, robustness, and speed for defined sensor applications. Materials having predictable and tunable recognition properties, as well as robustness under anticipated manufacturing schemes, are desired. Work may include modeling of material/analyte interactions and design of specific binding sites. Also of interest are biologically sensitive materials and materials with biorecognition surfaces and membranes. Packaging materials and methodologies specific to sensing applications are also of interest.

2. New approaches for achieving sensitivity, selectivity, robustness, low cost and high speed for defined sensor applications. These might include but are not limited to: (a) development of biologically-motivated amplification schemes and sensing principles, (b) development of label-free assays for various pathogens (including recognition schemes for surface proteins, glycoproteins and other surface markers for rapid detection of pathogens), and (c) development of functionally defined selectivity (e.g. neurotoxicity). Exploration of the dynamic behavior of sensors for various applications is another possible research area.

3. New approaches for the integration of diverse sensor data, including homogeneous arrays, higher order arrays, and superarrays. Development of new statistical algorithms and sampling theories tailored to specific sensor applications.

4. New approaches leading to miniaturization strategies, including lab-on-a-chip projects and power and vacuum pumping capabilities (for miniaturization of mass spectrometers or chromatographs, for example).

To quote the Workshop Report, "Sensor and sensing system projects should show a clear relationship to requirements of the application. Sensors and sensing systems cannot be viewed as isolated devices or scientific accomplishments. They have to be integrated into the solution of real problems."

Preparation, Submission and Evaluation of Requests

Supplement Requests and Small Grants for Exploratory Research (SGER) Proposals should follow the procedures specified in the NSF Grant Proposal Guide (NSF 02-2), http://www.nsf.gov/pubs/2002/nsf022/start.html. Supplements are described in Chapter 5, section B4. Small amounts of supplemental funding and up to six months of additional support may be requested. SGER's are described in Chapter 2, section 11f. The maximum SGER award amount is $100,000. The project's duration will normally be one year but may be up to two years.

As is usual for supplement requests and SGER proposals, Principal Investigators should first contact their Program Officer. Further information is available from Maria Burka, Chemical and Transport Systems, mburka@nsf.gov, 703-292-7030, or Janice Hicks, Chemistry, jhicks@nsf.gov, 703-292-4956.

We look forward to working with the research community to facilitate new avenues for innovations in sensing research and to speed the transfer of research results into practical device applications.

Sincerely,

Donald Burland
Acting Division Director
Division of Chemistry

Thomas W. Chapman
Acting Division Director
Division of Chemical Transport Systems

Thomas Weber
Division Director
Division of Materials Research

Bruce Hamilton
Division Director
Division of Bioengineering and Environmental Systems

Related Programs of Interest

Integrated Sensing, Computation and Networked Systems for Decision and Action, NSF-02-039, http://www.nsf.gov/cgi-bin/getpub?nsf02039

Dear Colleague Letter: Engineering Design for Uncertainty - Response to September 11th, Design, Manufacture and Industrial Innovation, http://www.nsf.gov/cgi-bin/getpub?nsf02052

Small Business Innovation Research and Small Business Technology Transfer Programs Phase I Solicitation (SBIR/STTR), http://www.eng.nsf.gov/sbir

Integrated Research and Education in Environmental Systems (see Instrument Development for Environmental Applications IDEA), http://www.nsf.gov/home/crssprgm/be/start.htm

Grant Opportunities For Academic Liaison With Industry (GOALI) NSF 97-116 http://www.eng.nsf.gov/goali/

Chemistry Research Instrumentation and Facilities (CRIF), see section on Instrument Development. Check Chemistry website for details for next competition: http://www.nsf.gov/mps/divisions/che/news/c_notices.htm#program

Major Research Instrumentation (MRI), see section on Instrument Development http://www.nsf.gov/od/oia/programs/mri/start.htm